THURSDAY, APRIL 11, 1878

THE APPLICATION OF ELECTRICITY TO RAILWAY WORKING

The Application of Electricity to Railway Working. By William Edward Langdon, Member of the Society of Telegraph Engineers; Superintendent (Engineering Department) Post-Office Telegraphs; and late Superintendent of Telegraphs on the London and South-Western Railway. (London: Macmillan and Co., 1877.)

IF any proof were needed of the vast and important services that science has conferred upon man, no more eloquent example could be instanced than that great combination of the conceptions of Stephenson and of Volta—the locomotive and the voltaic battery—which combination in its elaborated form is known as the railway system of the present time.

Living as we do in the midst of conveniences of transit, the mere belief in the possibility of which would, fifty years ago, have made a man a fit inmate for a lunatic asylum, we are apt to lose sight of the complexity of the problem that has been solved and to forget the all-important part which science has played in rendering such a state of things not only possible, but an accomplished fact of so familiar a nature as to have become a necessary part of our very existence. But when it is remembered that upon most of the lines of railway in and around London several hundred trains are running daily[1] at intervals varying from three minutes to half an hour, that each of those trains requires a separate series of signals only to protect it from collision, and that interspersed with the regular traffic "specials," "light engines," and trains out of time have to be provided for and protected against (to say nothing of the goods traffic, or of shunting, crossing and junction operations), it will be readily understood that traffic management, holding in its hands the power of life and death, is no easy task; and that without some very elaborate combination of sound administrative organisation with scientific instrumental aid, the traffic of a single hour would soon become an inextricable tangle of confusion.

Notwithstanding the great importance of the subject, involving as it does the safety of millions of human lives, it is somewhat surprising that technical literature should hitherto have been devoid of a work upon the very essence of safety in railway working—the application of the electric telegraph and of electric signalling to traffic management. This need has now been very ably supplied by the work before us, every page of which bears upon its face the evidence of being written by a thoroughly practical master of the subject in all its details and ramifications, and at the same time by one who possesses an exceptional power of making the subject clear to his readers.

In a handbook of a particular application of electricity it is refreshing to find that no valuable space is occupied by matter to be found in every elementary text-book of physics, that neither Thales with his amber nor Galvani with his frogs are even mentioned, and that descriptions of the various forms of the voltaic battery find no place in the book. The author presupposes that the necessary elementary knowledge is possessed or can be obtained by his readers, and disposing in one page of a few necessary introductory definitions plunges at once into his subject.

The work is arranged in three principal divisions:—(1) Speaking telegraphs; (2) Block signalling; and (3) Miscellaneous appliances. Under the first division a chapter is devoted to descriptions of the various speaking instruments and of the methods by which they are worked. The second chapter treats of signalling regulations, and while being of special value to all professionally engaged in railway working must prove most instructive and interesting to outsiders, who are thereby let into some of the technical mysteries of telegraphy. Every one is familiar with blank spaces left at the head of the telegraph forms issued by the Post Office, against which are printed the words "Prefix," "Code time," "Words," &c., but comparatively few know their meaning. The *Prefix* to a telegram is a signal letter or abbreviation to indicate the character of the message which follows, and therefore the order of its precedence for transmission. The *Code time* is a similar abbreviation to indicate the exact time at which a communication is handed to the telegraph clerk for transmission; and the space marked "Words" is set apart for signalling to the distant station the number of words contained in a message which gives to the receiving clerk a check upon his correct reading of the signals by which the communication is transmitted.

In railway telegraphy the prefix **D.R.** (**Danger**) gives to the message precedence over all others, and should never be employed except in cases of great emergency. Other prefixes **SP.** (for **special service**), **DB.** (for **ordinary traffic**), and various others are employed in railway signalling, by which the degree of its urgency is indicated before the message itself is transmitted.

The system upon which the **Code time** is abbreviated is very ingenious, and will be readily understood by referring to Fig. 1, which we have borrowed from Mr. Langdon's book. Opposite the hour figures on the dial of a clock are placed the twelve letters, A, B, C, D, E, F, G, H, I, K, L, and M, and against the four minute divisions between the hour figures, are placed the letters R, S, W, X, which, as will be seen in the sketch, are repeated all round the dial A simple time-code is thus obtained, by which any hour or minute throughout the day can be expressed in from one to three letters; thus 2 o'clock would be signalled by B, 2.45 by BI, and 7.12 (the time shown in the figure) by G, B, S, that is, G for seven hours, B for ten minutes, and S for the remaining two minutes to make up the twelve.

The technical regulations for railway telegraphing and traffic management are treated very fully. In this the author's large experience from having had the superintendence of the telegraphs of one of the most important lines of railway in the country is most apparent and gives great weight to his remarks, which ought to be committed to memory by all concerned in the management of railways; for if rigidly enforced and carried out, railway accidents would become well-nigh impossible, except from failure of instruments, from the breaking-down of rolling-stock, or from damage to permanent way.

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[1] During some portions of the day as many as seventy-five trains run through Clapham Junction Station in an hour, and between 900 and 1,000 is the daily aggregate average.

The second division of the book is devoted to the consideration of the block system, first conceived by Sir William Fothergill Cooke, and to the instruments and regulations by which that system which is the great guardian of the safety of railway travelling is carried out. It begins with a short historical notice of the subject, and, after explaining some of the elementary principles upon which the various instruments are constructed, proceeds to describe the different systems for carrying the block system into effect. The chapters devoted to this subject are embellished by a large number of excellent illustrations; each system being treated in a chapter to itself, which is a tolerably complete treatise on the subject.

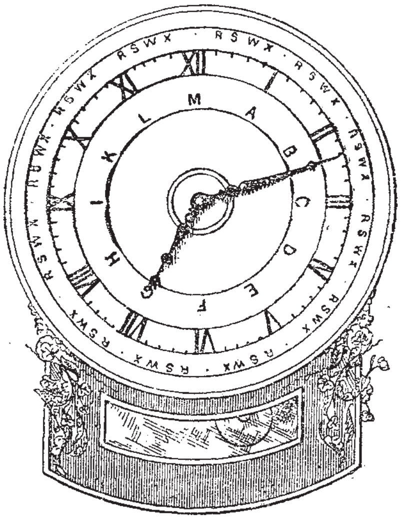


FIG. 1.

The beautiful arrangements of Mr. Preece, in which the indications of the signalling instruments as well as their manipulation are identical with those of the outdoor signals, are clearly described, as well as the systems of Mr. Walker, of Messrs. Tyer, and of Mr. Spagnoletti, all of which are very extensively used in this country. The system of Messrs. Siemens Brothers so largely employed on the Continent, a description of which concludes this part of the book, is specially remarkable for the fact that in it batteries are dispensed with, the necessary electric currents for working the instruments being derived from small magneto-electric machines.

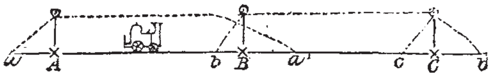
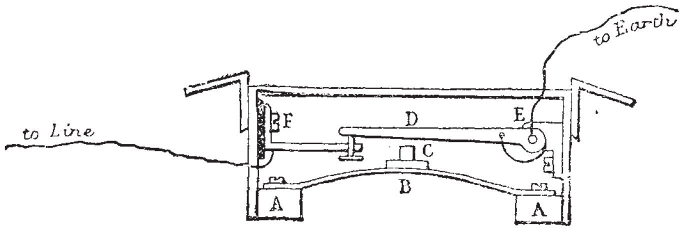


FIG. 2.

The various schemes that have been devised for making the train work its own signals, either by depressing "treadles" on the line, or by otherwise making electrical contacts, form a very interesting chapter, in which the systems of Mr. Imray, of London, of Mr. Rousseau, of New York, and of Dr. Whyte, of Elgin, are described and rendered clear by means of drawings and diagrams of the apparatus.

The essential principle of what is known as the block-system, is the insuring of there always being a certain distance between two trains travelling on the same line of rails. To carry this out the line is divided into a number of sections or "blocks," and the traffic is so regulated, that it is impossible for two trains to be in the same section at the same time. As a train enters one section, the signal behind it is set at danger, and is not lowered until the train has passed into the next section, which is similarly protected, and thus throughout the whole of its course a train cannot follow it at a distance less than the length of a section, or the distance between signal and signal. This is the one principle of the block system and all the various arrangements devised by different inventors differ only in the details by which it is carried out.

In Rousseau's arrangement, which may be taken as a type of the automatic systems of block signalling, the train in its progress depresses treadles on the line, which, by making electrical contacts with suitable apparatus, set the signals at danger as the train enters one section, and releases them as it passes into the next. A general idea of this system may be obtained by referring to Fig. 2, in which A, B, and C represent three signals, and the spaces A B and B C two sections of the line; at *a* is a treadle by which A is set at danger, and at *a'* is another by which it is released; similarly a treadle at *b* sets the signal B at danger, and a second at *b'* lowers it to the *all clear* position. A train, therefore, in passing *a*, which it does just before entering A B, will block that section against following trains by the signal A; travelling to B it will, in passing *b*, set B at danger, and not until it passes *a'*, when it is well out of the section A B, can the signal A be set at *all clear*, permitting a following train to enter A B.



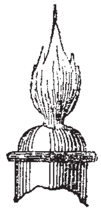


FIG. 3.

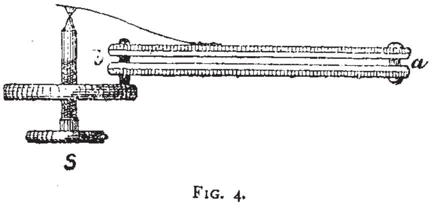


FIG. 4.

In the system of M. Brunius, which is under trial on the state railways of Sweden, telegraphic communication is made between the stations and the engine of the train, so that not only can ordinary signals be transmitted to the engine-driver, but he can receive instructions by telegraph.

Miscellaneous appliances employed in railway telegraphy are treated in the third division of Mr. Langdon's book, and an interesting chapter is devoted to the various "signal repeaters" and "light recorders." By the former, which were first employed by Mr. Preece, the position of the out-door signals is reproduced in miniature within the signal box, so that the signalman knows at once if the outside signals are correct. Light recorders are instruments which give warning, within the signal box, of the extinction of the light of the outside night-signals. Of these several forms have been devised but they all depend upon the expansion of metallic substances when subjected to the influence of heat and their subsequent contraction when that heat is removed. Fig. 3 is a cross-section of the transmitting portion of one of these instruments, in which B represents a concave disc of copper attached by its edge to the ring A A, a short distance above the flame of the lamp. When the light is out the lever D rests on the contact screw attached to the arm F (as shown in the figure) and the circuit is closed between the "line" and the earth, and an electric bell is set ringing in the signal box at the same time as an instrument indicates the words "*Light out.*" When, however, the plate B is heated by the flame below it, it becomes expanded, lifting the stud C, which, pressing against the lever D, lifts it off the contact screw, thereby breaking the circuit. The bell ceases ringing and the indicating instrument falls back to the signal "Light *in.*"

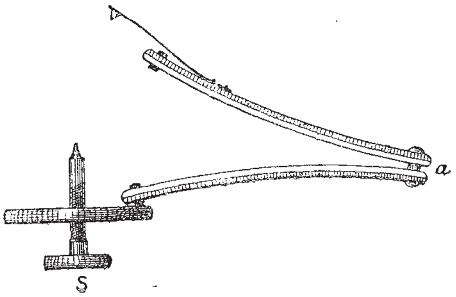


FIG. 5.

Figs. 4 and 5 represent a different arrangement for producing the same result, in which the contact-maker consists of two compact bars of dissimilar metals, constructed after the manner of a metallic pyrometer, and united together at the end A with the similar metals facing one another. By this arrangement the arc of motion is largely increased and the instrument is in consequence rendered more sensitive. Under the influence of heat the bars curve in opposite directions, as shown in Fig. 5, but on the light becoming extinguished their differential contraction brings them to the position shown in Fig. 4, contact is established, the bell rings, and the signal "Light *out,*" is transmitted to the receiving station.

The important subjects of the interlocking of points and signal levers, of level crossings, and the working of railway yards, all find their place in Mr. Langdon's book; and very interesting chapters are devoted respectively to the various kinds of electric bells, to lightning protectors for telegraphic instruments, and for the methods devised by different inventors and adopted by different railway companies for establishing intercommunication in trains.

It is not easy within the limits of the space at our disposal to do anything like justice to Mr. Langdon's most useful work, which is a thorough exposition of the subject in all its branches by one who not only has had a very large practical experience of the application of electricity to railway working, but who has the gift of clear description and a power of interesting his readers.

To all engaged in railway management whether directors, engineers, traffic managers, station-masters, signal-men, engine-drivers, or guards, Mr. Langdon's work will become a necessary text-book and book of reference, and the general scientific reader will find it most interesting and instructive. We must congratulate its author upon having put so much valuable information in so small a space, and its publishers upon having issued it in so cheap and attractive a form. C. W C.

TROLLOPE'S "SOUTH AFRICA"

South Africa. By Anthony Trollope. (London: Chapman and Hall.)

THERE are probably few of our Colonies the relations of which to one another are so little understood by the general public as those of South Africa, and none where events of so extraordinary a nature have occurred within the last few years. There are few Englishmen, therefore, by whom these charming volumes will not be read with delight and interest, coming as they do from a man of so much experience and of such liberal views as Mr. Trollope. The arrangement of the book is good and clear, each of the colonies being treated separately; a few chapters being devoted to a general introduction, and a few to the native tribes. The author has been led thereby into a somewhat unnecessary, possibly unconscious, repetition, when introducing each new district to his readers. This clearly arises from the fact that the origin of each colony is the same—the desire of the Boers to free themselves from British rule, their consequent occupation of new lands beyond the English border, and the necessity of our ultimately stepping in to govern them, both for their own good and for that of the natives. Mr. Trollope states that the objects of his interest are men and women, and it is to learn their condition, both socially and politically, that he visited South Africa.

Cape Colony, the oldest, largest, and most flourishing one, contains at present about 750,000 inhabitants, one third only of whom are white, and of the latter but one-third are English. These numbers indicate at once the very slow progress of the colony, and show that it is far from popular amongst emigrants, which Mr. Trollope thinks is due to the fact that here, and here only, the white labourer has to compete on equal terms with the native. The country seems closely to resemble the Riviera, though on a larger scale, both in scenery and capabilities. A great deal of the best lands, about 80,000,000 acres, is in private hands, of which only 550,000 acres are cultivated, being 1-145th of the private lands, and not one-fourteenth as Mr. Trollope has it. The great drawback to the country is the want of irrigation works when almost every European plant could be grown. Amongst other things, has not the cultivation of